



DEPARTMENT OF THE NAVY  
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ND

IN REPLY REFER TO

OPNAVINST 11310.3A  
OP-442  
07 February 1992

OPNAV INSTRUCTION 11310.3A

From: Chief of Naval Operations

Subj: OPERATION AND MAINTENANCE POLICY FOR SHORE-TO-SHIP POWER

Ref: (a) OPNAVINST 11000.16A of 28 Apr 87 (NOTAL) (R)  
(b) National Fire Protection Association NFPA 70B  
"Electrical Equipment Maintenance" (NOTAL)  
(c) National Electrical Code ANSI C2-90/NFPA (R)  
70-90 (NOTAL)  
(d) Electrical Transmission and Distribution Safety  
Manual, NAVFACENGCOM P-1060 (NOTAL)

Encl: (1) Operation and Maintenance Guidelines for Electric (R)  
Power Distribution Systems Supplying Ships  
(2) Operation and Maintenance Guidelines for Portable  
Shore-to-Ship Electric Power Cables

1. Purpose. To provide minimum operation and maintenance procedures for electrical systems which provide shore-to-ship power.

2. Cancellation. OPNAVINST 11310.3.

3. Applicability. Applies to all Navy-owned components of electrical distribution systems between each power source (commercial utility metering point or Government-owned generator) and each shore power connection point on board ships. Electrical components which are not directly involved in supplying power to ships, but which can affect the reliability of those circuits, are also included. This instruction does not apply to electrical components aboard ships or components used exclusively to deliver 400 Hertz, supershore, or direct current power or any power for major ship repair or overhaul. All shipyards are excluded from this instruction.

4. Discussion. The safe and reliable operation of shipboard electrical equipment is critical in port as well as at sea. A malfunction or misapplication of shore-to-ship power equipment could cause at least an inconvenient interruption of electrical service to a ship at berth. At worst, it could threaten the lives of personnel, damage critical shipboard and shore power equipment, or completely disable a ship. Unfortunately, problems



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- R) with shore-to-ship power systems are too frequent now and may become more common as ship's power requirements increase in the future. Investigations by Commander, Naval Sea Systems Command (COMNAVSEASYSCOM) and Commander, Naval Facilities Engineering Command (COMNAVFACENGCOM) have shown that improperly trained ship and shore personnel and inadequately maintained shore-to-ship power equipment are the major causes of those problems. Because the requirements are so critical and the waterfront environment is so harsh on electrical equipment, it is imperative to apply the highest standards to the operation and maintenance of electrical distribution systems that supply shore-to-ship power to the fleet. Reference (a) establishes Chief of Naval Operations policy and command responsibility for Navy controlled land and shore facilities. Enclosures (1) and (2) address specific elements that must be included in each activity's shore-to-ship power operation and maintenance program. Reference (b) provides guidelines for electrical equipment maintenance.
- R) Electrical safety requirements and guidelines for safe practices to be followed during operation and maintenance are provided by references (c) and (d).

5. Action

a. Second Echelon Commands

(1) Ensure that subordinate shore activities and applicable fleet units develop shore-to-ship power operation and maintenance programs.

(2) Ensure that all projects to correct identified waterfront deficiencies involving shore-to-ship power support are submitted following reference (a).

b. Public Works Centers and Naval Shore Activities.

Those activities providing electrical cold iron power will:

(1) Establish a shore-to-ship power operation and maintenance program conforming to enclosures (1) and (2).

(2) Assess waterfront facilities, as they relate to shore-to-ship power, and submit projects to correct identified deficiencies following reference (a).

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c. Commanders of Forces Afloat

(1) Establish standards for shipboard personnel for the checkout and connection of the power cables on board ship and ensure that subordinate units apply the standards.

(2) Develop required changes to shipboard operating procedures in support of the shore-to-ship power operating procedures established by this instruction.

d. COMNAVFACENGCOM

(1) Evaluate shore-to-ship electrical power outages and recommend corrective actions for design, operation, and maintenance of shore-to-ship power systems.

(2) Provide support to COMNAVSEASYS COM for the identification and solution of interface problems between ships' electrical distribution systems and shore-to-ship power systems.



P. W. DRENNON  
by direction

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OPERATION AND MAINTENANCE GUIDELINES FOR  
ELECTRIC POWER DISTRIBUTION SYSTEMS SUPPLYING SHIPS

1. Training. Training programs will be developed by each ship and shore activity for all ship and shore based personnel involved in the operation and maintenance of shore-to-ship power systems. The program will include the installation, fabrication, assembly, and testing of low and medium voltage cable, splices, terminations, connectors, switchgear, and receptacles, where applicable. Reference (b) can be used as a guide for local training programs. Reference (b) may be obtained from the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210. Navy sponsored training courses and manufacturers' training will be used to the maximum extent possible to supplement local training. Safety training shall be included and emphasized (R) by all cognizant commands. Fleet commanders will establish standards for personnel working on shore-to-ship power systems. The activities will maintain training records and conduct periodic refresher training programs.

2. Safety. Prevent accidents and injuries by adequate job planning, observing all safety precautions and practices, and following proper procedures. Evaluate, identify, and control hazards before starting work. Follow the guidelines of references (c), (d), and activity Standard Operating Procedures (SOPs) per subparagraph 3a(6). (R)

3. Shore-to-ship Power System Operating Procedures. Basic power system operating guidelines are published in NAVFAC MO-201, "Operation of Electric Power Distribution Systems." Copies may be obtained from Navy Aviation Supply Office 03443, COG I Customer Service, 5801 Tabor Avenue, Philadelphia, PA 19120-5099. The following additional procedures will be applied to all shore-to-ship power systems.

a. Standard Operating Procedures (SOPs). SOPs will be prepared by each activity and distributed to all personnel involved with the operation and maintenance of shore-to-ship power systems. The SOPs will address, as a minimum, the following areas:

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- (1) Organization
- (2) Responsibilities
- (3) Priorities
- (4) Normal Procedures
- (5) Emergency Procedures
- (6) Safety and Health Requirements and Considerations

b. Critical Component Identification. All electrical components whose failure could affect the reliability of the electrical distribution system supplying power to ships will be identified as critical components of the shore-to-ship power system and will be placed under the maintenance program defined in this enclosure.

c. One-line Diagrams. One-line diagrams, illustrating the equipment ratings and system configuration of all critical components, will be prepared and kept current by the activities. Plot plans will be annotated to show the location of all shore-to-ship power system components. See NAVFAC MO-204 "Electric Power System Analysis," for additional information.

R) d. Power System Study. An activity power system study, including load flow, fault current analysis, and coordination of protective devices will be prepared or updated at least once every five years or sooner if required by major modifications to the activity's or utility company's electrical distribution system. The study will evaluate the adequacy of all critical components of the shore-to-ship power system defined in subparagraph 3b. All protective devices which could directly or indirectly cause ship power failure will be evaluated to determine compliance with the American National Standards Institute (ANSI) guidelines and the National Electrical Code. The cognizant COMNAVFACENGCOM Engineering Field Division (EFD) will perform Utility System Assessments (USAs) to assist the activity in evaluating changes to the shore-to-ship power systems. The EFD will then recommend, as appropriate, a power

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system load flow, fault current, or protective device coordination study, to be performed either by the activity, the EFD using their Computer Assisted Utility Systems Engineering (CAUSE) facilities, or by contract. USAs and CAUSE studies shall be performed following NAVFACINST 11300.37. (R)

e. Voltage Requirements. Voltages at the shipboard power receptacles shall be 450 volts plus or minus 5 percent.

f. Transportable Substation. Transportable substations or other portable equipment used to supply power to ships will be included in the maintenance program defined in this enclosure.

g. Paralleling Transformers. If a ship is supplied by two or more shore transformers, the ship's operating force will be directed, through standard ship operating procedures, not to parallel the transformers through the ship's bus unless the senior ship's electrician verifies correct phase orientation between power sources, and the supplying activity authorizes the parallel operation. If shore transformers are paralleled through the ship's bus, short circuit currents may be increased to unsafe levels and circulating currents may overheat and destroy cables, transformers, and switchgear on board ship or on shore.

h. Paralleling Shipboard Generation with the Shore Power System. Paralleling of ship's service generators with the shore power system is prohibited except for the shortest time necessary to transfer load to or from shore power.

#### 4. Shore-to-ship Power System Maintenance Standards

a. General. The basic electrical equipment maintenance guidelines, as outlined in NFPA 70B, "Electrical Equipment Maintenance," will be used as minimum maintenance standards. Additionally, NAVFAC MO-200, "Facilities Engineering, Electrical, Exterior Facilities"; NAVFAC MO-322, "Inspection of Shore Facilities"; and manufacturer's maintenance recommendations will be used as supporting guidelines for all shore-to-ship power system equipment. Maintenance schedules listed will be adjusted

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so as not to interfere with normal waterfront operations, e.g., schedule maintenance when critical components are not required for ship support.

b. Continuous Inspection Schedules. Inspection checklists will be prepared by each activity and used for all shore-to-ship power system critical components. A checklist will be prepared for each type of preventive maintenance if there is more than one type, e.g., semi-annual, annual, etc. The checklists will include everything that is to be done during the scheduled maintenance. Signed off copies of checklists will be filed with maintenance records. Inspection schedules will be prepared and followed for all shore-to-ship power system critical components. Maintenance intervals published in reference (b), NAVFAC MO-200, and MO-322 may be adjusted based upon local conditions and experience. However, maintenance intervals will not exceed the times listed in reference (b).

c. Maintenance Records. A maintenance history record will be established and maintained covering each shore-to-ship power system critical component. The history will record all work and indicate what was done and by whom. Testing and test records will be a part of each critical component's maintenance record. Maintenance records will also be used to identify excessive unscheduled maintenance so that problems may be diagnosed and corrected.

d. Switchgear Operations. Whenever switchgear devices included on the critical component list operate because of an overload, overcurrent, or short-circuit, air circuit breakers will be carefully inspected for damage to contacts, arc chutes, frame, and operating mechanism. Oil circuit breakers will be inspected and maintained as outlined in MO-322. Shipboard operational requirements may require maintenance other than visual inspections to be temporarily deferred, but not to exceed the times listed in NFPA 70B for maintenance intervals.

e. Testing. Critical components will be tested during regular maintenance intervals following the requirements of reference (b).

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OPERATION AND MAINTENANCE GUIDELINES FOR  
PORTABLE SHORE-TO-SHIP ELECTRIC POWER CABLES

1. General

a. Low Voltage Cables (Rated 600 Volts and Below). The portable cables utilized within the shore-to-ship power system will be supplied as specified by MIL-C-915E (NOTAL) and MIL-C-915/6 (NOTAL). The cable will be three conductor, flexible, unshielded type THOF-500 construction. The cable will be rated for at least 600 volt service and should normally operate at 450 volts, 3 phase, 60 Hertz. The 450 volt cables are available from stock at the Defense Industrial Supply Center (DISC) (R Philadelphia, PA with the following information:

THOF-500 NSN 6145-01-008-5468

Equivalent cable from other sources may be considered. Low smoke cable specified by MIL-C-24643 which is for use on ships, shall not be used for shore-to-ship power applications, (R because its softer jacket is susceptible to damage.

b. Medium Voltage Cables (Rated 601 to 5000 Volts). The portable cables used for the 4160 volt shore-to-ship power system will be three conductor, flexible, braided shield type SHD-350GC, 8,000 volt insulated, with PVC jacket. Insulation will conform with Insulated Power Cable Engineers Association (IPCEA) S-66-524 (NOTAL). Jacket materials will comply with IPCEA S-19-81 (NOTAL). Medium voltage cables presently are available only from commercial sources.

2. Operation of Portable Shore-to-ship Power Cables

a. Low Voltage Cable Overcurrent Protection. The shore-to-ship cables are rated to carry a maximum continuous load of 400 amperes. The 450 volt pier substation circuit breaker long time overcurrent protection will be adjusted to trip at continuous loads of 440 amperes to prevent overload damage to the cables or ship's electrical system.

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b. Medium Voltage Cable Overcurrent Protection. The 4,160 volt shore-to-ship cables are rated to carry a maximum continuous load of 360 amperes. The 4,160 volt pier substation circuit breaker long time overcurrent protection will be set to trip at a maximum of 400 amperes to prevent overload damage to the cable or ship's electrical system.

c. Standard Cable Lengths. Activities will maintain an inventory of portable shore-to-ship electric power cables in lengths required for ships. Lengths will be selected and constructed to minimize the requirements for in-line connections. All cable runs serving ships from a pier mounted 450 volt turtleback will be of equal length to minimize unequal load sharing.

d. Cable Storage. Cables not in use should be stored in a dry, weatherproof location. Covered off pier storage locations are highly desirable. Cable ends, terminations, and plugs will be protected against contamination and moisture when not in use.

e. Number of Shore-to-ship Circuits

(1) The number of shore-to-ship circuits using three conductor cables required to supply power to a particular ship depends upon the estimated power requirements of the ship. The power requirements vary depending upon the ship's activity while in port. Each low voltage cable is limited to 400 amps steady state at 450 volts. The medium voltage cables are limited to 360 amps at 4.16 KV.

(2) The ship's force should provide estimated ampere load requirements to the shore operators. When the available shore power is less than the estimated ship load, the ship's force will be notified of the available capacity of the shore-to-ship power system. When more than one circuit is required all cables will be the same length and conductor sizes will be matched to minimize unequal load distribution.

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f. Cable Terminations

(1) Low Voltage Terminations. All low voltage cables will be terminated with a MIL-C-24368/1 plug at each end of the cable. The connectors will be assembled on to the cable using approved methods as detailed in publication DOD-STD-2003 (NOTAL), Figure E15, which is available from Navy Aviation Supply Office 03443, COG I Customer Service, 5801 Tabor Avenue, Philadelphia, PA 19120-5099. Portable shore power cable jumpers, supplied by the ship, will be used only where piers do not have MIL-C-24368/2 type receptacle and plug assemblies. Cables serving submarines will have a MIL-C-24368/5 outboard plug connection permanently attached to the shipboard end. (R)

(2) Medium Voltage Terminations. All medium voltage cables will be terminated at the shore end with a three phase 5,000 volt, 400 ampere plug. The shipboard end of the cables will be terminated with MIL-E-16366, two hole bolted lug type terminals.

g. Low Voltage System In-line Connections. In-line connections may be used only if operationally necessary. The in-line connection may use single pole connectors such as MIL-C-24368/4 or three pole connectors such as the following:

<u>Cage</u>	<u>Connector Assembly</u>	<u>Cog.</u>	<u>Fed. Supply Class</u>	(R)
90129	X 8998-1 Male	1 H	0099-LL-H28-0067	
90129	X 8998-2 Female	1 H	0099-LL-H28-0068	

Connectors shall be watertight, oil resistant, and ensure proper phase orientation. Selection of the equipment shall be determined by the activity.

h. Shore-to-ship Power System Service Connections

(1) Connecting the shore-to-ship power system cables to the pier receptacles will be accomplished only by qualified shore electricians in direct coordination with an electrical supervisor from the serviced ship. A checklist with detailed, sequential step-by-step connection procedures will be developed by the activity providing the cold iron electrical service. The

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checklist will show the date, ship, pier, and outlet number and will be signed by both the shore electrician and the shipboard electrician in charge when the hookup is completed. The checklist should then be filed at the Public Works Office and retained for at least 1 year.

(2) The checklist will address at least the following:

(a) Visual inspection for damage of each cable to be connected.

(b) Inspection of the cable terminations to ensure they are clean, free from salt, moisture, and corrosion, and are undamaged.

(c) Electrical insulation resistance tests of each cable assembly showing actual values measured. Cables having insulation readings below 1,000,000 ohms for 450 volt cables and 5,000,000 ohms for 4,160 volt cables will not be placed in service. Shop testing and repair will be initiated for cable in that category.

(d) Shore power outlets are de-energized before connecting the cables.

(e) Connect the cables to the pier shore power outlets.

(f) If the ship is supplied by more than one shore transformer, the electrician will instruct the ship's operating force that paralleling of shore transformers through the ship's bus is prohibited unless authorized by the cognizant activity based on a fault current analysis, paragraph 3g, enclosure (1).

R)

(g) Energize the cables only after the ship grants permission to transfer to shore power.

(h) Record and obtain a signed acknowledgment of available shore power and any special instructions given to ship's operating force.

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(3) Ship's forces are responsible for rigging the cables on board the ship, verifying phase rotation on each cable and for completing the connection on board the ship. The shore activity will assist in rigging cable in some cases.

3. Maintenance of Portable Shore-to-ship Power Cable

a. Shop Test. The shop test procedures given in NAVFAC MO-200 will be performed on all cables and connectors which fail insulation resistance tests or pre-installation inspections. The tests can be used to locate cable faults and to verify cable integrity after repairs are completed. Cables which fail shop tests and cannot be economically repaired will be removed from service permanently.

b. Repair. Insulation repairs, entailing damage to outer cable jacket with conductor insulation intact, should use approved materials only. An approved material or kit will provide abrasion resistance and will remain flexible over a wide range of temperature. The completed insulation repair must have a moisture seal and the seal must be permanently bonded to the cable insulation. Repair kits and materials, which carry a Bureau of Mines approval number or use a vulcanized rubber molding for insulating, are the only materials which are approved for use on portable shore-to-ship power cables. For procedures to repair cables with a damaged outer jacket or conductor insulation, refer to paragraph 3c.

c. Splicing. Splicing of portable shore-to-ship power cables is not recommended. If splices cannot be avoided, however, low voltage cables may be spliced when the spliced connections are insulated with an insulating material which conforms to the requirements of paragraph 3b and NCEL Technical Note N-1503 (NOTAL). Copies may be obtained from Commanding Officer, Naval Civil Engineering Laboratory, Port Hueneme, CA 93043, Code L07. Medium voltage power cables will not be spliced under any conditions.

Enclosure (2)